

VII GE HIGH SPEED CARD READER

GENERAL DESCRIPTION

The GE high speed card reader (Figure VII-1) is a free-standing unit which operates through a controller, but not through the controller selector. It reads standard 80-column punched cards in continuous-feed mode at a maximum speed of 1500 cards per minute. It reads in single-feed mode, with a Halt Card Reader instruction after each card, at a speed of 850 cards per minute. Card reading can proceed simultaneously with

computing operations and with other input-output of information into and out of the central processor.

Cards are fed singly by a vacuum pick-off, and are moved by a moving belt past dual photoelectric read heads where they are read column by column (serially). The cards may be read in three modes: 12-row binary, 10-row binary, and Hollerith (decimal). The same instructions are used in programs for the 1000 card per minute reader as are used for the 400 card per minute reader and card data formats are the same for both. (See Section VI of this manual for a description of the three modes.)

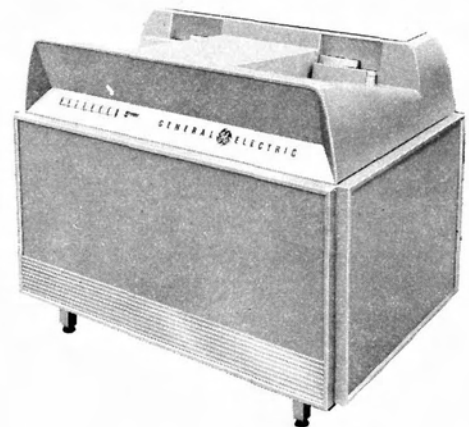


Figure VII-1. GE High Speed Card Reader

Card Reader Controller

The controller consists of two pluggable modules (D and E) which are housed in the first rack of the central processor. All communication between the central processor and the card reader is provided by the controller which is connected by cable to the central processor and to the card reader. Basic timing for the controller is from the central processor, but the speed at which data is transmitted is dependent on the timing of the card reader. Card data is sent from the reader to the controller, and the controller in turn sends the data to the central processor. Data in 10-row and 12-row binary modes is transferred without modification, but data received in the decimal mode is converted to BCD by a decoding matrix in the controller.

Card Reader Mechanism

Both the input hopper and the stacker have a 2000 card capacity. They can be easily loaded and unloaded while the reader is in operation. The reader has its own power supply, a blower source, and a vacuum source. It has the necessary logic to provide the timing to tie into the logic of the central processor and to provide error checking within the reader.

Card reading is initiated by a signal from the central processor. This signal causes a coil to pull back the actuators in front of the moving belt in the feed gate at the end of the input hopper. A combination of a vacuum and riffle air at the gate assures the fast movement of a single card. In the transport area, (Figure VII-2) the

card moves with the belt, between plate guides, and between tension rollers and stub rollers. The card moves through the read station, around the turn-around roller, and into the stacker, where riffle air at the output gate again assists the card movement.

THE SENTINEL WORD

It is important that the operator understand the meaning and effects of the reader's checking features. The very last word formed in the reading of a card is called a 'sentinel' word or a 'synchronization' word. This word performs many useful functions. It can be interrogated by the program and, if necessary, can be transferred to the A register where it can be read from the A register of the console. The sentinel words vary slightly in the three different modes, but the modes have the following in common:

Bit Position

0	When set to 1 indicates the last word of card was read
1	When set to 1 indicates the last card in hopper has been read
16	When 0 indicates stacker full
18	When 0 indicates a read (synchronization) error
19	When 0 indicates input hopper empty and EOF is set

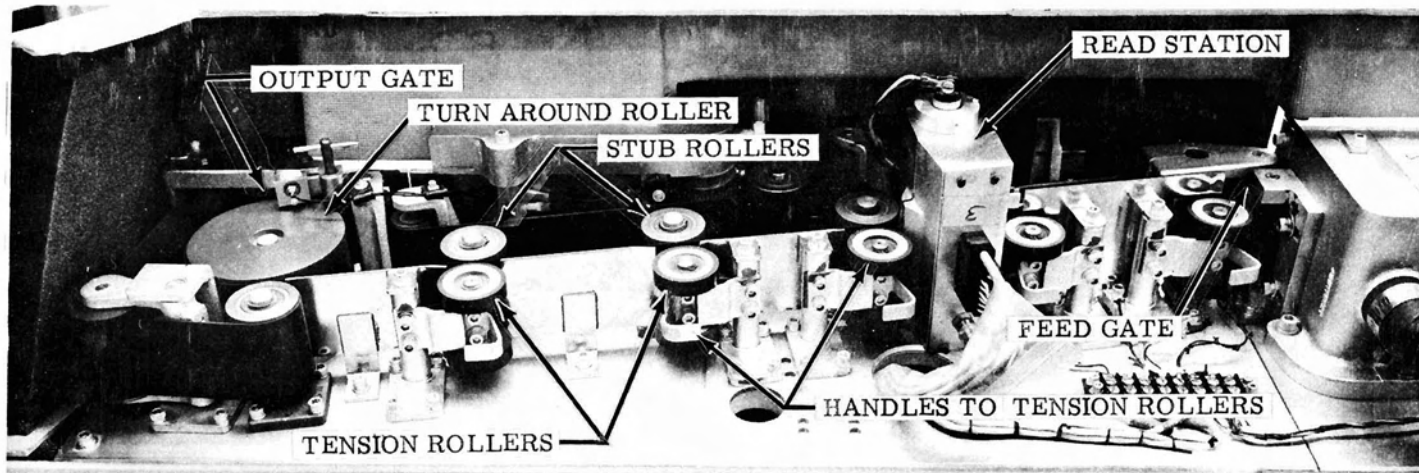


Figure VII-2. Card Transport Area

The decimal mode has a checking feature which the binary modes do not have -- a check for an invalid character. Detection of an invalid character causes a Q to appear in the 17th bit position of the sentinel word. The sign position of the word containing one or more invalid characters is also set to 1 so the word can be identified.

Section VI describes the formation of memory words from card columns 1 through 80. Because 84 read pulses are generated for each card, words are formed in memory from data produced by read pulses 81 through 84. Eighty three pulses occur before the end of card is reached. The 84th pulse occurs after the end of the card, causing the card reader to send all ones. The following is a summary of the memory words formed by the 84 read pulses for each mode of card reading.

Decimal Mode

Cards are repeatedly read into the same 4-card memory locations, beginning at location Y, as follows:

- (1) Y to Y+26
- (2) Y+32 to Y+58
- (3) Y+64 to Y+90
- (4) Y+96 to Y+122

The following memory words are formed by the 84 read pulses:

<u>Card Columns</u>	<u>Memory Words</u>
1 - 78	26 words of 3 BCD characters each
79 - 81	27th word of 2 BCD characters and a space character (octal 60)
82 - 84	28th word, a sentinel word of 2 space characters and 6 check digits as indicated in the following examples

Examples of sentinel words for the decimal mode are:

- (1) Last word of a card, no error conditions
10 110 000 110 000 111 111 (octal 2606077)
- (2) Last word of last card in hopper has been read, but EOF was not set, no error conditions
11 110 000 110 000 111 111 (octal 3606077)

- (3) Last word of card and stacker is full
10 110 000 110 000 110 111 (octal 2606067)
- (4) Last word of card and an invalid character
10 110 000 110 000 111 011 (octal 2606073)
- (5) Last word of card and a read error
10 110 000 110 000 111 101 (octal 2606075)
- (6) Last word of card and the input hopper empty and EOF is set.
11 110 000 110 000 111 110 (octal 3606076)

10-Row Binary Mode

Cards are repeatedly read into the same 2-card memory locations beginning at location Y, as follows:

- (1) Y to Y+39
- (2) Y+64 to Y+103

The following memory words are formed by the 84 read pulses:

<u>Card Columns</u>	<u>Memory Words</u>
1 - 80	40 words of 20 binary bits each
81 - 82	41st word of all zeros
83 - 84	42nd word, a sentinel word as shown in the following examples

Examples of sentinel words for the 10-row binary mode are:

- (1) Last word of card, no error conditions
10 000 000 001 111 111 111 (octal 2001777)
- (2) Last word of last card in hopper has been read but EOF was not set, no error conditions
11 000 000 001 111 111 111 (octal 3001777)
- (3) Last word of card and stacker is full
10 000 000 001 111 110 111 (octal 2001767)
- (4) Last word of card and a read error
10 000 000 001 111 111 101 (octal 2001775)

- (5) Last word of card and input hopper empty and EOF is set

11 000 000 001 111 111 110 (octal 3001776)

12-Row Binary Mode

Cards are read into 84 successive memory word locations, using only bit positions 8 through 19 of each word. The following memory words are formed:

<u>Card Columns</u>	<u>Memory Words</u>
1 - 80	80 words of 12 binary bits each
81 - 83	May be anything
84	A sentinel word having check digits as indicated in the following examples

Examples of sentinel words for the 12-row binary mode are:

- (1) Last word of card, no error conditions
10 000 000 111 111 111 111 (octal 2007777)
- (2) Last word of last card in hopper has been read, but EOF was not set, no error conditions
11 000 000 111 111 111 111 (octal 3007777)
- (3) Last word of card, stacker full
10 000 000 111 111 110 111 (octal 2007767)
- (4) Last word of card and a read error
10 000 000 111 111 111 101 (octal 2007775)
- (5) Last word of card and input hopper empty and EOF set
10 000 000 111 111 111 110 (octal 307776)

It should be noted that the operator has direct control over whether bit position 19 of the sentinel word becomes a 0 or a 1. He should make sure that the EOF indicator is on only when the programmer has asked for the EOF switch to be activated.

ERROR CONDITIONS

The following error conditions are described so that the operator can learn to identify the type of error when it occurs. Remedial action by the operator is explained wherever applicable.

Feed Error

A feed error occurs when the card reader is operable, cards are in the hopper, yet a card fails to feed when it is called for. At the time of such an error, the following occurs:

1. On the card reader, the FEED ERROR light comes on.
2. On the control console, the CARD READER READY light goes off.
3. The program continues to call for a card (program is most likely in a loop).

Operator action to correct the error and continue the program is as follows:

1. Correct the feed by placing the card to be fed at the entrance of the feed gate, flush against the riffle air housing. Make sure remaining cards are properly aligned.
2. Unlatch the feed plate if it had been latched.
3. Depress the OPERATE switch on the card reader.

This procedure may be repeated again if card feed does not start.

Read Error

A read error occurs when there is a failure of the light source, failure of the solar cells or amplifiers, or an error in timing (synchronization). Phototransistors, located along the moving belt in the transport area, check the card's movement against the timing gear. Checks are made between the feed gate and the read station and the read station and the output gate. At the time of a read error, the following occurs:

1. The READ ERROR indicator on the reader is illuminated.
2. A Q is placed in the 18-bit position of the sentinel word.

No operator corrective action is required. Unless corrective action is programmed, the leading edge of the next card (after the one causing the read error) will turn off the READ ERROR indicator. The read error may occur while only a portion of the card is being read. When this happens, only part of the data may be in error, and possibly none of it is in error.

When the program causes reading to halt at the time of a read error, the programmer will provide the necessary instructions for the operator. In this case, the READ ERROR indicator remains lit until the OPERATE switch is depressed.

Hopper Empty

Each time a card is read, a check is made to determine whether the input hopper is empty. If it is empty, cards, of course, do not feed and the following occurs:

1. The reader signals the controller, and the controller becomes 'not ready.'
2. On the control console, the CARD READER READY light goes out.
3. On the card reader, the OPERATE switch turns red, indicating an inoperable condition.
4. On the card reader, the BIN EMP light comes on.
5. A 1 is placed in the 1-bit position of the sentinel word. If the EOF switch had been depressed by the operator, a 0 is also placed in the sentinel word, in the 19-bit position.

If the program contains a test for reader ready, it remains in a loop until the operator takes the following corrective action.

1. Loads cards into the hopper.
2. Unlatches the pusher plate and places it in position against the cards.
3. Depresses the OPERATE switch on the card reader.

The controller will now become ready and cards will continue to feed. Only the sentinel word indicates to the programmer that the bin has become empty.

Stacker Full

Each time a card is read, a check is made to determine whether the stacker is full. If it is full, the following occurs:

1. If cards are being read in the continuous mode, cards continue to be fed for about 50 cards beyond the stacker full signal, at which time a safety inhibit-feed switch is activated to stop card reading.
2. If cards are being read in a noncontinuous mode, a HCR command stops the card feed and causes the controller to become 'ready.'
3. The stacker full switch sends a signal to the controller which results in the placing of a 0 in the 16-bit position of the sentinel word. (In the continuous mode, this could occur to all 50 cards fed beyond the stacker full signal.)
4. On the card reader, the BIN FULL light comes on.
5. On the control console, the CARD READER READY light goes out.

To continue operation, the operator must take the following action:

1. Remove cards down to the card removal mark on the side of the stacker.
2. Lower the stacker plate until it rests against remaining cards.
3. Depress the OPERATE switch on the card reader.

Cards will continue to feed. The sentinel word indicates to the programmer that the stacker has been full.

Phantom Feed

A phantom feed is the occurrence of a card passing through the feed gate without being called for by the program. When this occurs, no information from the



Figure VII-3. Reader Control and Indicator Panel

Holding a switch down could cause an error. See Table VI for a summary of the functions of controls and indicators. Figure VII-4 is a view of the top of the card reader.

1. Depress the card reader power ON switch, and wait for the sound of the blowers (about 6 seconds) before proceeding. The switch glows amber when power is on.)
2. Load cards into the input hopper as follows:
 - a. Slide the hopper's pusher plate (feed plate) to the top of the hopper where it will remain held by a magnetic latch. (BIN FULL indicator will glow)
 - b. Place the first card of the deck, face first and 9-edge down, so that the leading edge is in the feed throat and flat against the
 - c. ruffle air housing, thereby raising the bin-empty switch (Figure VII-4).
 - d. Place the cards in the hopper, face first and 9-edge down.
 - e. Repeat steps c and d until all cards are loaded or until the input hopper is full.
 - f. Slide the feed plate down against the card deck. (BIN FULL indicator light will go off.)

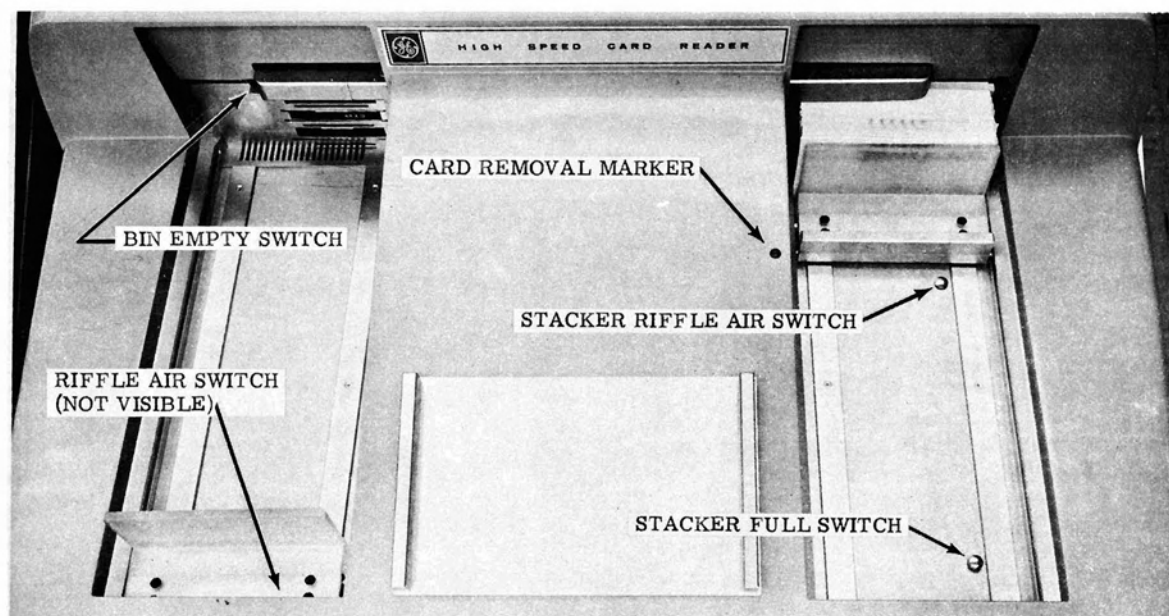


Figure VII-4. Top View of the Card Reader

3. Check to see that the stacker pusher plate is at the bottom of the stacker so it rests against the output gate.
4. If the READ ERROR switch is illuminated, depress it to turn out the light and clear the circuitry.
5. Depress the OPERATE switch. The OPERATE indicator will glow green if the BIN EMP and BIN FULL indicators are not lit. This also clears the FEED ERROR indicator.
6. Check to make sure that the EOF switch is set correctly. The EOF indicator light should be off unless the programmer has specified that the switch be on after loading cards. (The EOF pushbutton is a 2-position switch and indicator which is lit when it is on.)
7. Follow the applicable procedure at the console of the central processor as described below.

Procedures for loading cards into memory depend upon whether the cards contain a program or merely data for use after the program is in memory. In the following, it is assumed that power to the central processor is on, the INSTR/WORD switch is set to INSTR and the AUTO/MANUAL switch is set to MANUAL.

Loading a Program Deck. The first card must be a loader card punched in binary format. (All switches referred to are on the console of the central processor.)

1. Depress the RESET ALARM switch.
2. Depress the LOAD CARD switch. (This loads the first card image into memory beginning with location 00000.)
3. Depress the RESET P switch.
4. Return the AUTO/MANUAL switch to AUTO.
5. Depress the START switch to begin automatic feed of the cards under program control.

Loading a Data Deck. It is assumed that there is a program in memory and that it will load the data cards as they are needed.

1. Depress the RESET ALARM switch.
2. Manually introduce a branch instruction into the A register, using the console switches as follows:
 - a. Raise option switches 0, 2, and 3 to set octal code 26 for the branch instruction BRU.

- b. Raise option switches (7 through 19) to set the operand portion of the instruction to the octal representation of the memory location of the first instruction of the program. For example: If the first instruction of the program is in memory location (2146, octal), the switches should be set as illustrated:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	0	1	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	0
2		6			0			2			1			4			6		

3. Depress the A to I switch to transfer the branch instruction to the I register for execution.
4. Return the AUTO/MANUAL switch to AUTO.
5. Depress the START switch to transfer control to the program which automatically feeds the rest of the cards.

Adding Cards. Although the input hopper holds 2000 cards, it is sometimes necessary to add cards while the reader is in operation and the hopper is partially full. Cards should be added when the card deck in the hopper is at least 5 inches thick. If too few cards remain, they fall over at the feed gate and cause a misfeed. The procedure for adding cards is as follows:

1. Joggle a handful of cards on the top of the reader.
2. Slide the feed plate back, but not as far as the latched position if card feed is to continue without stopping.
3. Add cards to those in the bin with one hand while holding the feed plate with the other.
4. Slide the feed plate down against the card deck.
5. Repeat the above four steps until all cards are added or the hopper is full.
6. After the last card of the program or data has been loaded, check to see whether the END OF FILE button must be on.

Removing Cards. When the program and/or data cards number more than 2000, it is necessary to remove cards while the program is running, as follows:

1. Slide the stacker's pusher plate back, but not far enough to depress the stacker full switch if card feeding is to continue without stopping.*
2. Remove cards to but not beyond the red button

on the inside edge of the stacker (labeled the 'card removal mark' in Figure VII-4). The button indicates where cards must be to activate the stacker riffle air switch. The increased riffle air turned on by the switch is needed to prevent feed errors.

3. Slide the pusher plate down until it rests against the card deck.

* If either the feed plate or the stacker plate is latched during reading operations, card feeding will stop and the READER READY indicator on the console will go off. To continue reading (after adding or removing cards and returning the feed or stacker plate to operating position) the operator must depress the OPERATE switch on the card reader.

TABLE VI

FUNCTIONS OF CONTROLS AND INDICATORS
FOR THE GE HIGH SPEED CARD READER

Location	Control or Indicator	Function
Card reader control and indicator panel	OFF switch	Turns power off to card reader.
	ON switch and indicator	Turns power on to card reader. Switch glows amber when power is on. (Central processor power must be on before this switch is operable.)
	OPERATE switch and indicator	Readies circuitry for on-line operation. Switch glows green when ready, red when not ready.
	READ ERROR indicator	Indicates that there was a malfunctioning lamp or photocell in the read area or a synchronization error. Glows red at time of read error.
	FEED ERROR indicator	Indicates that the program called for a card but no card was fed even though cards are in the input hopper. Glows red at time of feed error.
	BIN EMP indicator	Indicates (by glowing red) when card input hopper is empty.
	BIN FULL indicator	Indicates (by glowing red) when stacker is full.
	END OF FILE switch	Sends end-of-file signal to the central processor when last card has been read. Glows amber when on.
Protrudes from riffle air housing at lower end of input hopper	Bin Empty switch	Stops card feed and activates the BIN EMP indicator
On bottom of stacker	Stacker Riffle Air switch	Increases considerably the amount riffle air at the entrance to the stacker. Switch is activated by the cards which push over it.

TABLE VI (CONT.)

Location	Control or Indicator	Function
On bottom of stacker	Stacker Full switch	Stops card feed. It is activated when the card pusher plate moves over it.
Control Console	CARD READER READY light	Indicates when card reader is ready for operation. Glows green when ready.
	LOAD CARD switch	Starts cards feeding through the card reader.
	CARD READER alarm light (red)	Indicates, when lit, that card reading was attempted while the card reader was not ready (not set up, busy, mis-feed, or card jam).
	CARD READER READY light (green)	Indicates, when lit, that the card reader is in a 'ready' status.
	RESET ALARM switch	Clears any alarm condition (AUTO/MANUAL switch must be in MANUAL position before this switch is effective)
	LOAD CARD switch	Causes feeding and reading of one card (punched in binary format) into memory location 00000 (AUTO/MANUAL switch must be in MANUAL position before this switch is effective)
	RESET P switch	Resets the P register to zero
	AUTO/MANUAL switch	Controls automatic or manual mode of operation
	START switch	Initiates card reading

SPECIAL PROCEDURES

Clearing Card Jams

Card jams can result from either malfunctioning equipment or from cards in poor condition. The operator can usually correct jams by simply removing the jammed card or cards. No more than three cards are ever in the transport area at one time. Procedures for removing cards are as follows:

1. Remove the cover to the transport area. This is easily done by the operator if he stands to the rear of the reader and slides the upper back panel toward him, pulling it by the handle (see Figure VII-2).
2. Locate the area of the jam. It will most likely be at the feed gate, the read station, or the output gate.
3. Remove the tension on the jammed card and the transport belt by pulling the hooks attached to the tension roller or rollers closest to the card. (By pulling on the metal hook-like handle on the side of the tension roller, the roller can be moved about a quarter of an inch away from the belt, freeing the card.)
4. Remove the card, cards, or any pieces of cards if one became torn. Do this only by pulling the card with one's fingers; never use any tools on the equipment.
5. If a card was torn and there is any possibility that pieces of card remain in the transport area, move two or three cards by hand from the feed gate to the output gate. To do this, place a card in the mouth of the feed gate (from the input hopper) and move the transport belt by hand by turning the turn-around roller clockwise until the card has passed into the stacker.
6. If the cards in step 5 did not pass the length of the transport area freely, it means torn bits of a card remain, and a service engineer must be called to remove the card fragments.

Reproducing Cards

Cards may be reproduced by the card reader as follows:

1. Place the card to be reproduced in the input hopper, at the feed throat, in position for reading.

2. Place the feed plate against the card.
3. With the computer in manual, place in the A register the instruction RCD (2500000)₈ for a decimal card or RCB (2500001)₈ for a binary card. Transfer the contents of the A register to the I register by depressing the A to I switch.
4. Depress the START button on the console. The card reader will read that card into memory starting at location 0000.
5. Place in the A register the instruction WCD (2500002)₈ to punch a decimal card or the instruction WCB (2500003)₈ to punch a binary card. Transfer the contents of the A register to the I register and depress START. The card punch will punch a card from memory starting with location 0000.
6. Remove the reproduced card from the card punch and visually compare it to the original card by placing the two cards together and looking through the punched holes. If the new card is not correct, repeat the reproduction procedure. If a correct card is not produced after the third try, the original card probably cannot be read and must be reproduced by other means.

Reconditioning Cards and Caring for Cards

These subjects are covered in Section VI and, with one exception, apply equally well to cards used with the high speed card reader. The exception is that thorough joggling of the cards is not as necessary for the high speed card reader as it is for the 400 card per minute reader.

ERRORS AND OPERATOR CORRECTIVE ACTION

Operator Checklist

If the operator neglects to do any of the following, the card reader will fail to operate correctly and may cause halts during runs.

1. Turn on card reader power and depress the OPERATE switch.

2. Set up the deck correctly: remove superfluous remarks cards, use correct loader card, and the correct transfer card.
3. Square up the deck before loading.
4. Release the feed plate in the input hopper.

5. Clear the CARD READER alarm on the console (depress RESET ALARM).

6. Unload the output hopper.

Table VII summarizes some of the error conditions the operator may encounter in card reader operation. As in all peripheral operations, half of the battle is won when the difficulty has been identified.

TABLE VII

GE HIGH SPEED CARD READER CONDITIONS

Error Condition	Possible Cause	Corrective Action
Reader feeds one card and halts	Necessary loader card not in deck or cards out of order	Add loader card or put deck in order. Reload cards and restart read operations.
CARD READER alarm light comes on, CARD READER READY light is off, computer halts	There was a phantom feed	Remove cards from stacker and return to nearest restart point or to beginning of program.
FEED ERROR light is on, CARD READER alarm is off, cards are not feeding	There was a feed error	Check and reposition card at feed gate. Depress the OPERATE switch to continue reading cards.
	Card will not load because its leading edge is wrinkled	Smooth edge of card. If it does not feed on next attempt, replace card with newly reproduced one, depress OPERATE and continue reading cards.
READ ERROR indicator comes on, cards are not feeding	Program called for a stop on a read error	Follow directions given by programmer for read errors. (There may be a typeout of directions.)
CARD READER alarm light and ECHO ALARM Lights come on, CARD READER READY light is off	Program tried to execute a read command while the reader was not ready	Stop the run and return the program to the programmer.

TABLE VII (CONT.)

Error Condition	Possible Cause	Corrective Action
BIN EMP light comes on, CARD READER READY light is off, cards are not feeding (END OF FILE light may also be on)	Input hopper is empty	Add cards to hopper, unlatch feed plate, and depress the OPERATE switch to continue reading cards.
FEED ERROR light is on, CARD READER alarm is off, cards are not feeding, transport mechanism is shut down	There is a card jam	If possible, remove card causing jam, return program to nearest restart point or to the beginning. (See paragraphs on Clearing Card Jams.)
BIN FULL light is on. CARD READER READY light is off, cards are not feeding	The stacker is full	Remove cards from the stacker, unlatch the pusher plate, depress the OPERATE switch to continue reading cards.
	The feed plate was left in the latched position	Unlatch the feed plate and depress the OPERATE switch to continue reading cards.
	The stacker pusher plate was left in the latched position	Unlatch the pusher plate and depress the OPERATE switch to continue reading cards.